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D2.7

Ensembles for decadal prediction extremal episodes downscaled to 1km/1h for Cyprus research site

April 2017

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BINGO

Bringing INnovation to onGOing water management – a better future under climate change

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Changes with respect to the DoA

No changes in respect to the DoA.

Dissemination and uptake

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Short Summary of results (<250 words)

This deliverable is about the generation of high temporal and spatial resolution data for future extremal precipitation episodes (15 days duration). This was achieved by applying the dynamical downscaling method. Three extreme rainfall events over Cyprus were identified from the global MiKlip decadal prediction system. Then they were dynamically downscaled with the Weather Research and Forecasting model (WRF), for 15-day periods centered over the peak of each event. An ensemble set of five model configurations was used for the downscaling. According to WRF all events are producing significant rainfall amounts, particularly over the Troodos mountains. Case 2023 can be characterised as extra-ordinary as, according to the model simulations, its 5-day total precipitation amounts (420 mm) breaks the observation records over the semi-mountainous regions of the BINGO research site of Cyprus (408 mm). The present report describes the downscaling tools and methodology while it also includes the results in the form of precipitation maps and hyetographs.

Evidence of accomplishment

This report. Data has been post-processed and will be distributed for use by hydrological impact models.

TABLE OF CONTENTS

1. INTRODUCTION

Although a reduction in precipitation and prolonged droughts will likely be a most significant impact of climate change in the eastern Mediterranean (Lelieveld et al., 2012), changes in extremes of rainfall are also expected (Paxian et al., 2015; Kitoh and Endo, 2016). These rare events, which can cause human casualties and significant infrastructure damage, are generally difficult to reproduce by models.

In this context, the objective of this deliverable is to dynamically downscale selected near-future extreme precipitation events for the research site of Cyprus. Output of this task, in the form of an ensemble set, will be used to drive hydrological impact models and study the potential risks. In consistency with previous tasks and as described in D2.5 report, for the Cyprus case study we used as a climate downscaling tool the Weather, Research and Forecasting Model (WRF). Output of the global MiKlip decadal prediction system were used to provide initial and lateral boundary conditions for the limited area model. MiKlip was downscaled to 12-, 4- and 1-km resolutions over the broader region of the eastern Mediterranean and eventually Cyprus following a one-way nesting approach.

In a previous task of WP2 we have tested a large number of WRF set-ups and parameterizations for convection and microphysical processes and we have optimised the model for the simulation of extreme precipitation events (Zittis et al. 2017). Accordingly, for this task, our five-member ensemble set is based on these best performing configurations.

The identification of the MiKlip future extreme events was based on large-scale circulation patterns and precipitation thresholds of observed events of the past (see Appendix A). Three severe potential future events were selected and dynamically downscaled to very high horizontal and time resolutions in order to be relevant for the BINGO project's hydrological applications.

2. DATA AND METHODOLOGY

2.1. Model and experimental setup

For the simulations of this study we used the version 3.7.1 of WRF model (Skamarock et al., 2008). We used the one-way nesting option, downscaling the global model to 12 km (Domain 1: D01) and subsequently to 4 km (Domain 2: D02) and 1 km (Domain 3: D03), as seen in Figure 1.

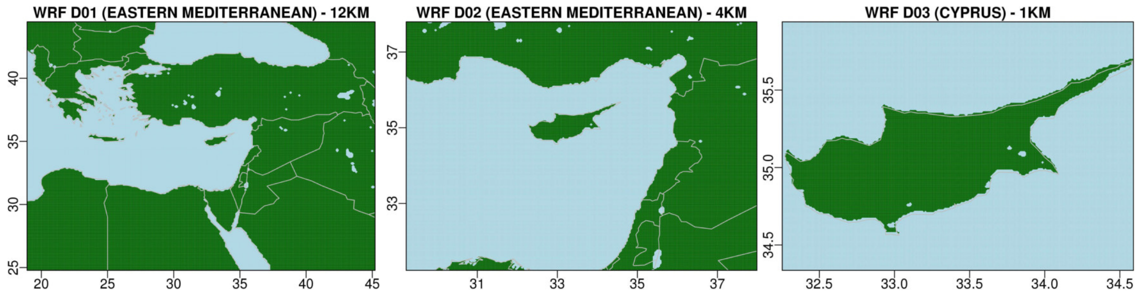

Figure 1 – Simulation domains of the eastern Mediterranean region centered over Cyprus for the 12 km (WRF-D01 – left panel), 4 km (WRF-D02 – middle panel) and 1 km (WRF-D03 – right panel) simulations.

The first downscaling domain (D01) represents more or less the area overlapped from the different CORDEX domains (https://www.cordex.org/) that are relevant for the research site of Cyprus (EURO-CORDEX, MENA-CORDEX, MED-CORDEX). The model was set up with 40 vertical levels and a top at 50 hPa. To be useful for hydro-climatological applications, all model output was saved in hourly intervals. We produced a five-member ensemble of WRF simulations according to Zittis et al. (2017). The physics parameterizations of each ensemble member are presented in Table 1. Noteworthy, for the finer 1-km domain (D03) we switched off the convection parameterization. In our past-events validation simulations (see report D2.5), this explicit treatment of convection was found to outperform the coarser 12 and 4-km simulations, particularly for the mountainous regions of the Cyprus research site. Besides microphysics and cumulus convection the rest of the physical parameterizations (Radiation, Planetary Boundary Layer, Land Surface Model) were consistent for all simulations (Table 1).

Table 1 – WRF Physics parameterizations applied in each ensemble member.

	Microphysics	Convection	Radiation	Planetary Boundary Layer	Land Surface Model
WRF-1	Ferrier[1]	Grell-Freitas[4]	RRTMG LW & SW Radiation Scheme[6]	Mellor-Yamada-Janjic (MYJ)	Noah LSM[7]
WRF-2	Ferrier	Betts-Miller-Janjic[5]			
WRF-3	WDM6[2]	Betts-Miller-Janjic			
WRF-4	WSM6[3]	Betts-Miller-Janjic			
WRF-5	WSM6	Grell-Freitas			

[1] NOAA, 2011
[2] Lim and Hong, 2010
[3] Hong and Lim, 2006
[4] Grell and Freitas, 2014
[5] Janjic, 1994
[6] Iacono et al, 2008
[7] Tewari et al, 2004

2.2. Boundary conditions

Near-future climate conditions for BINGO are available from the MiKlip decadal prediction system (http://www.fona-miklip.de). MiKlip is based on the Max Planck Institute's earth system model, MPI-ESM (http://www.mpimet.mpg.de/en/science/models/mpi-esm/). It has a global coverage and an atmospheric horizontal resolution of T63 (1.875°). The MiKlip system has been extensively tested for recent-past climate conditions and showed significant model skill (Müller et al., 2012; Pohlmann et al., 2013, Kadow et al., 2015). The decadal predictions were initialized in 2015 and cover the ten-year period up to 2024. This experiment consists of an ensemble set based on ten model realisations.

For this task's dynamical downscaling with WRF we used 6-hourly soil, surface and atmosphere data from the MiKlip ensemble as initial and lateral boundary conditions.

2.3. Description of case studies

Several near-future potential extreme precipitation episodes for the Cyprus research site were identified from the MiKlip decadal prediction system. This selection was based on the large-scale circulation synoptic patterns and the precipitation amounts over the eastern Mediterranean. As for all BINGO research sites, the identification of future extreme events was performed by FUB. A detailed technical report on the methodology used for Cyprus is available in Appendix A. Three of the most extreme cases were selected for further research and were downscaled with WRF. This subset includes the highest 1-day, 3-day and 4-day precipitation episodes according to the two MiKlip grid-points that cover Cyprus. All three selected events represent the late autumn – early winter rainy season, while more specific details are given in Table 2. For every case, the downscaling simulations had a length of 15 days.

Table 2 - Description of the future extreme precipitation episodes selected for downscaling.

	Simulation days	Season	Day of Peak	MIKLIP ensemble member	Average of two grid points over Cyprus	Comments
Case 2018	26/11-10/12	Wet	04/Dec	r7	86 mm / 72h	Maximum 3-day rainfall
Case 2022	11/12-25/12	Wet	19/Dec	r1	42 mm / 24 h	Maximum 1-day rainfall
Case 2023	08/11-22/11	Wet	14, 17/Nov	r9	107 mm / 96 h	Maximum 4-day rainfall

3. RESULTS

In the following sub-sections, we present the results of the downscaling for each case study. These are given in the forms of rainfall total maps and hyetographs (precipitation time-series) over selected grid points of special interest for the Cyprus research site. In the same context, we present the corresponding output of the global MiKlip decadal prediction system.

3.1. Case 2018

Projections for the November 2018 episode are presented in Figure 2. According to MiKlip (Figure 2 – left panels) during this potential future event the broader region of the eastern Mediterranean will be affected. Rainfall peaks of about 150-200 mm during an event in early December are found over the easternmost part of the basin. However, the coarse resolution of MiKlip and the averaging over large cells is not particularly useful for the case of Cyprus as all local processes are smoothed.

This localised information is now derived from the downscaling of MiKlip with WRF which is presented in the right panels of Figure 2. According to WRF simulations Figure 2 – top right and middle right panels), the peaks of precipitation are now located over the Adana region and off-shore the gulf of Alexandretta in south-east Turkey. The severity of the event is also increased over the aforementioned regions, where 5-day totals could likely be more than 350-400 mm of rainfall.

The bottom-right panel of Figure 2 reveals the potential impact of this episode over Cyprus. The mountainous regions of Troodos are the ones projected to receive more rainfall (up to 300-350 mm). Nevertheless, the risk for floods over the downstream flat areas could be high. As already mentioned, MiKlip precipitation over Cyprus is found uniform (Figure 2 – bottom left panel).

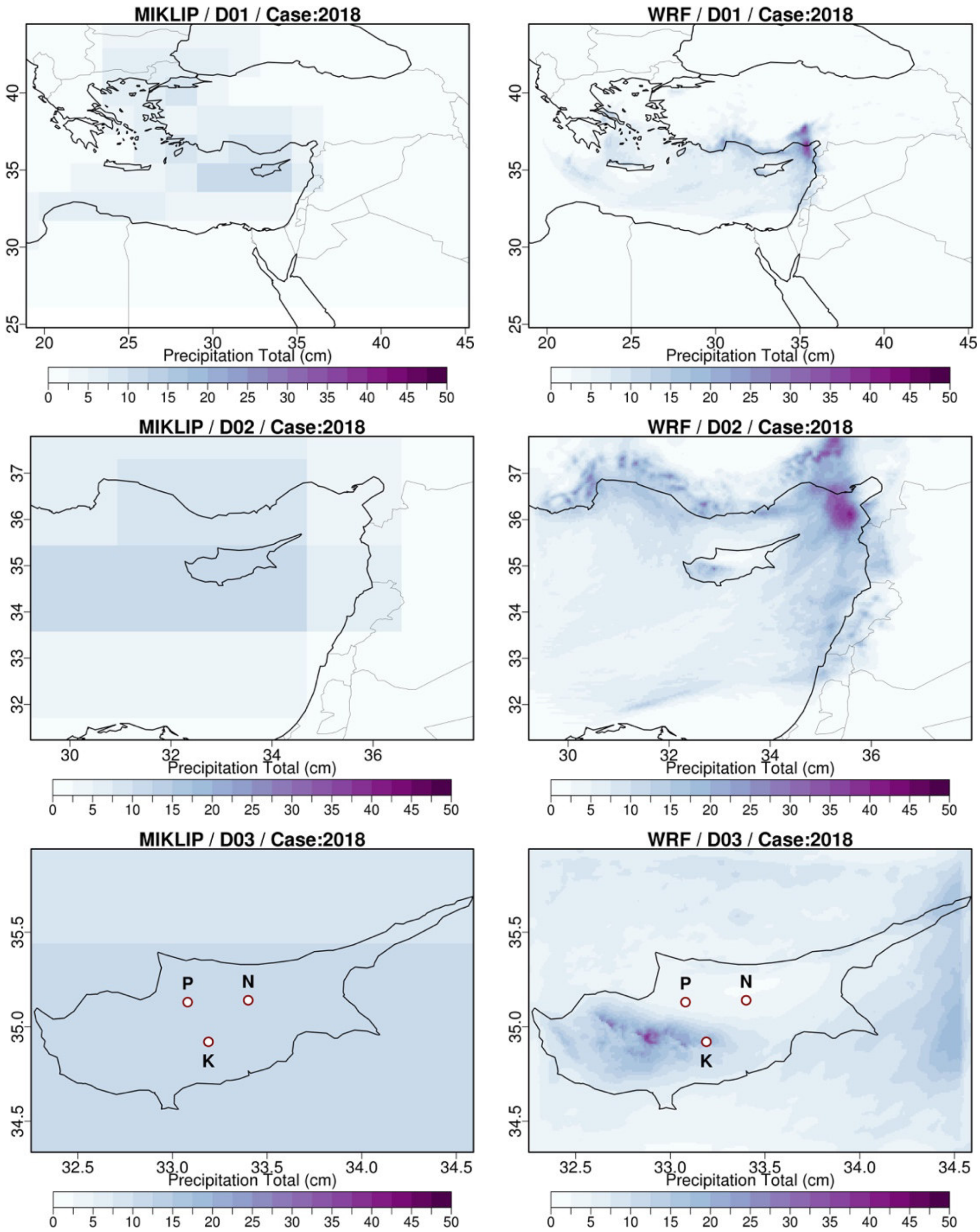

Figure 2 – Precipitation total over a 5-day period (02-06/12/2018) according to the Miklip decadal prediction system (left panels) and the ensemble mean of five WRF simulations (right panels). Letters in the bottom panels indicate Nicosia (N), Peristerona (P) and Kionia (K) station locations.

A better insight of the simulated event can be obtained through the relevant time-series. The tested locations are included in the Peristerona and Pedieos watersheds which are the main focus of the Cyprus BINGO site, have been discussed extensively in previous reports and are presented in Figure 3.

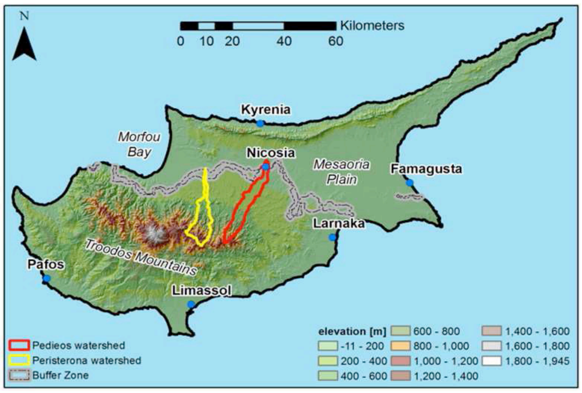

Figure 3 – Cyprus elevation map and outlines of the Peristerona and Pedieos watersheds in yellow and red respectively.

For the low-land Peristerona (Figure 4 – top left) and Nicosia (Figure 4 – bottom) WRF precipitation is found to be less comparing to the MiKlip projections. The time extend of the event is also found to be more limited. On the other hand, over the semi-mountainous Kionia region (Figure 4 – top right) the WRF ensemble generated substantially higher rainfall than the MiKlip simulation. A peak rate of more than 100 mm / 24h was simulated with the convection-permitting D03 simulations.

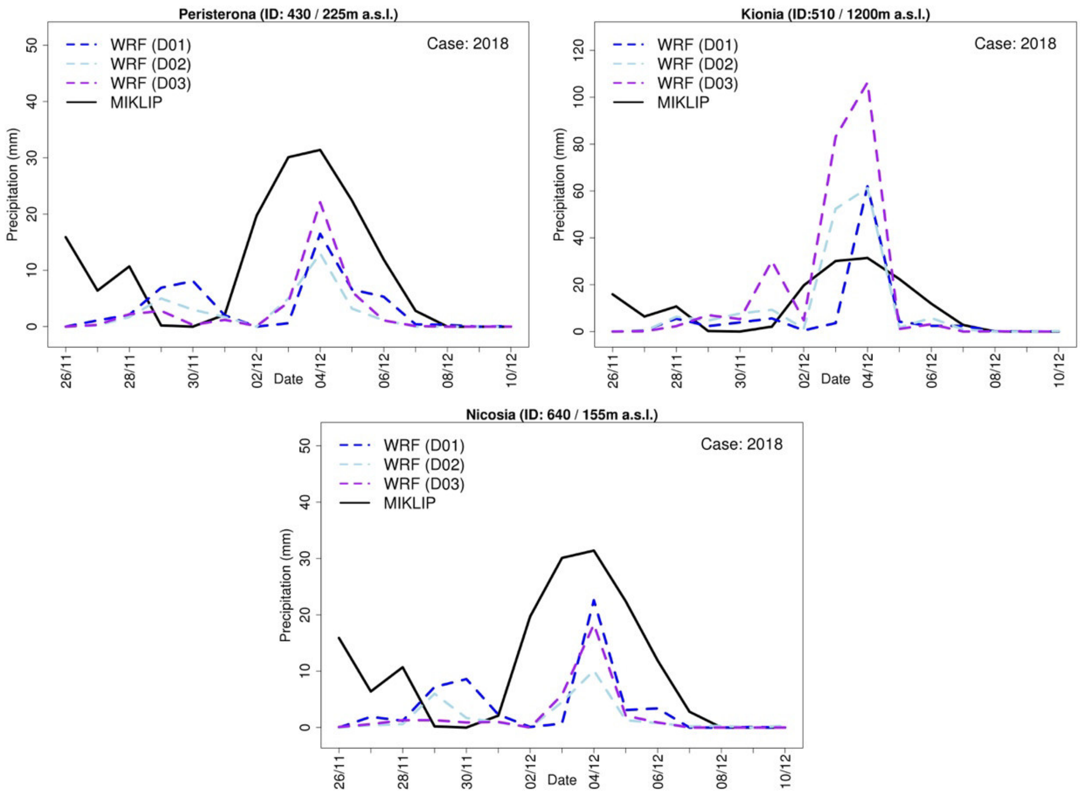

Figure 4 – Simulated precipitation time-series (daily totals) for the period 26/11-10/12/2018 over Peristerona, Kionia and Nicosia station locations in Cyprus.

3.2. Case 2022

The overall rainfall patterns during the December 2022 event are found similar to the 2018 case. The MiKlip decadal prediction systems suggests total precipitation amounts of about 150 mm over Turkey and eastern Mediterranean (Figure 5 – left panels). The WRF downscaling suggests less rainfall over continental Turkey but more than 300 mm over the south coast and the gulf of Alexandretta.

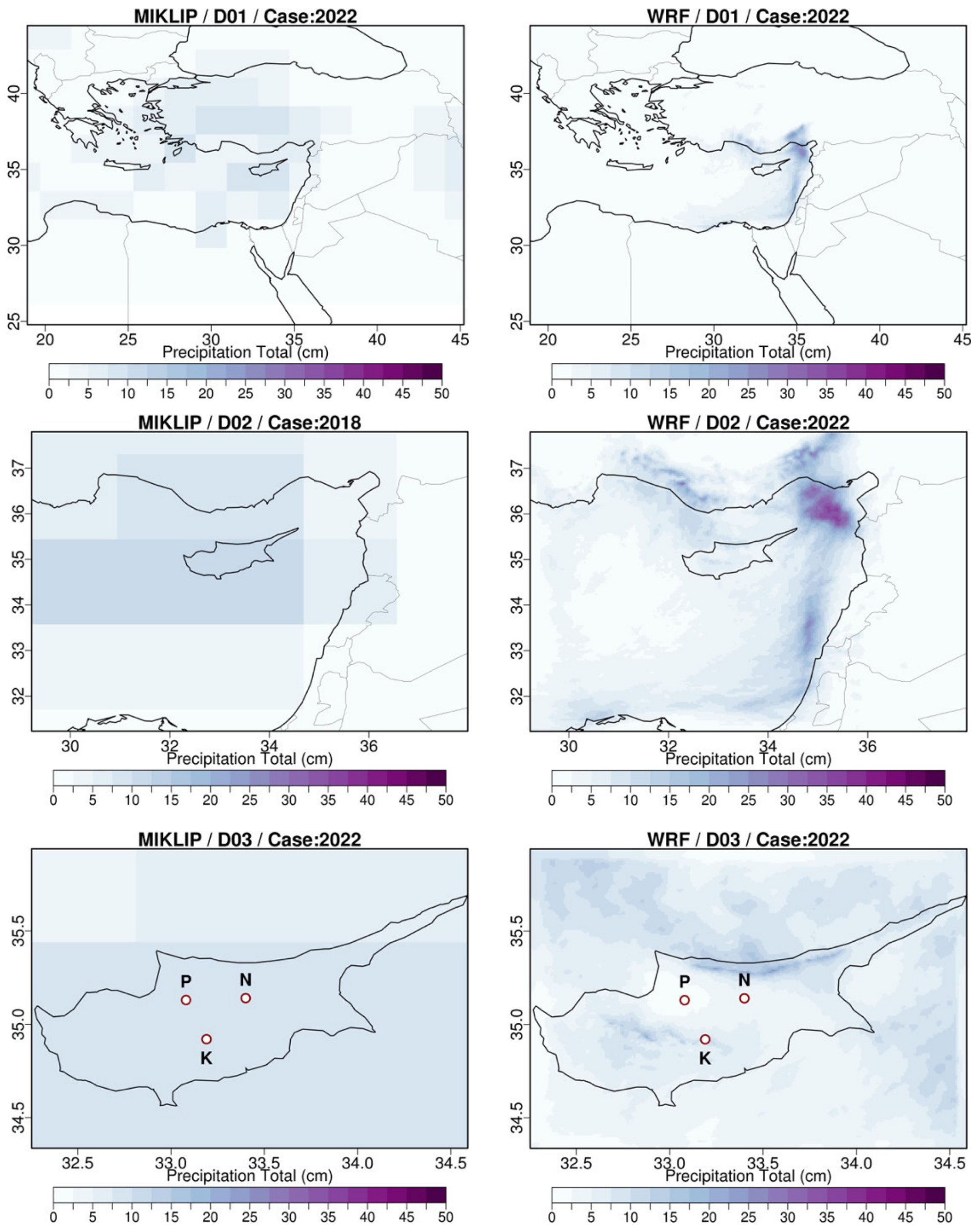

Figure 5 – Precipitation total over a 5-day period (17-21/12/2022) according to the Miklip decadal prediction system (left panels) and the ensemble mean of five WRF simulations (right panels). Letters in the bottom panels indicate Nicosia (N), Peristerona (P) and Kionia (K) station locations.

For the Cyprus research site MiKlip precipitation is found uniformly distributed over the island. The high-resolution WRF simulation (Figure 5 – bottom right panel) provide more regionalised information. More precipitation is generated over the Pentadaktylos mountain range located in the north part of the island and over Troodos mountains on the south-east. The hyetographs of Figure 6 indicate that for the two low-elevation stations (Peristerona and Nicosia) rainfall amounts during the peak of the event are close to the ones suggested by the MiKlip model (30-40 mm/24h). Over the Kionia station (Figure 6 – top right panel) the WRF D03 simulation is found again to generate a higher precipitation peak (60 mm/24h).

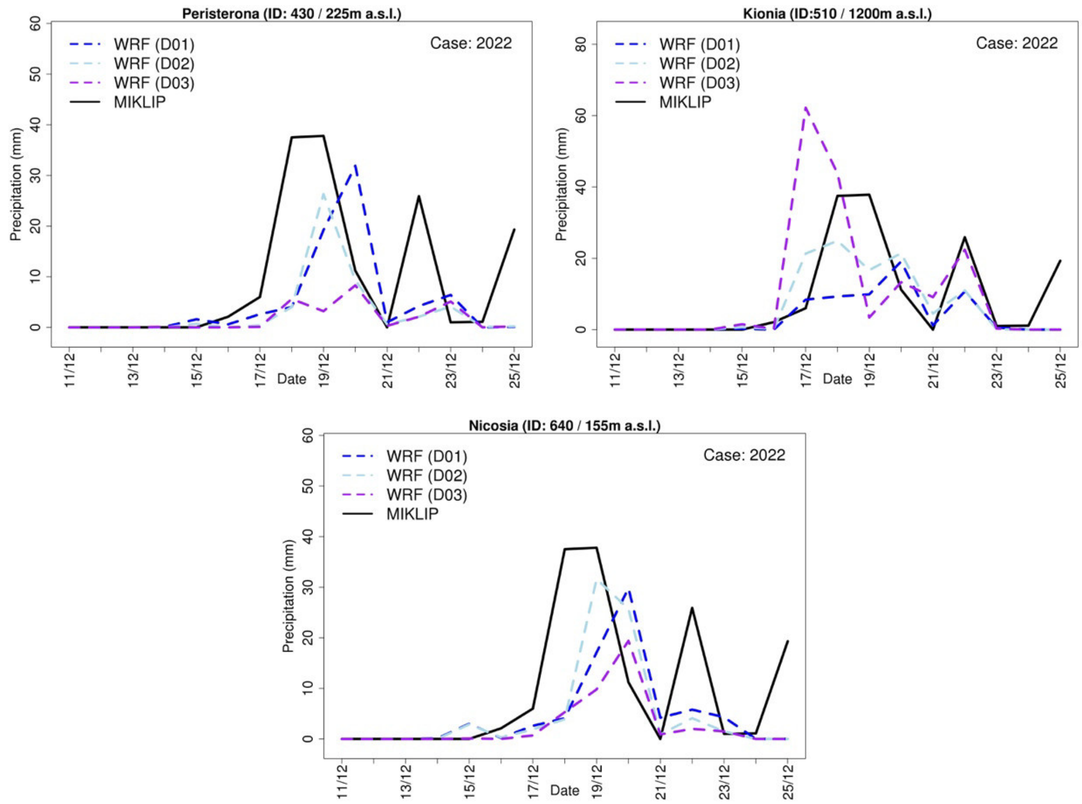

Figure 6 – **Simulated precipitation time-series (daily totals) for the period 11-25/12/2022 over Peristerona, Kionia and Nicosia station locations in Cyprus.**

3.3. Case 2023

This case is the most severe of the three selected cases. For the eastern Mediterranean 5-day precipitation totals of more than 200 mm are suggested by MiKlip (Figure 7 – left panels). WRF simulations are found much wetter and produced up to 400 mm precipitation totals for the 5-day duration of the November 2023 episode. Particularly for the island of Cyprus (Figure 7 – bottom right panel), more than 450 mm of total precipitation are produced by the regional model over the mountain of Troodos.

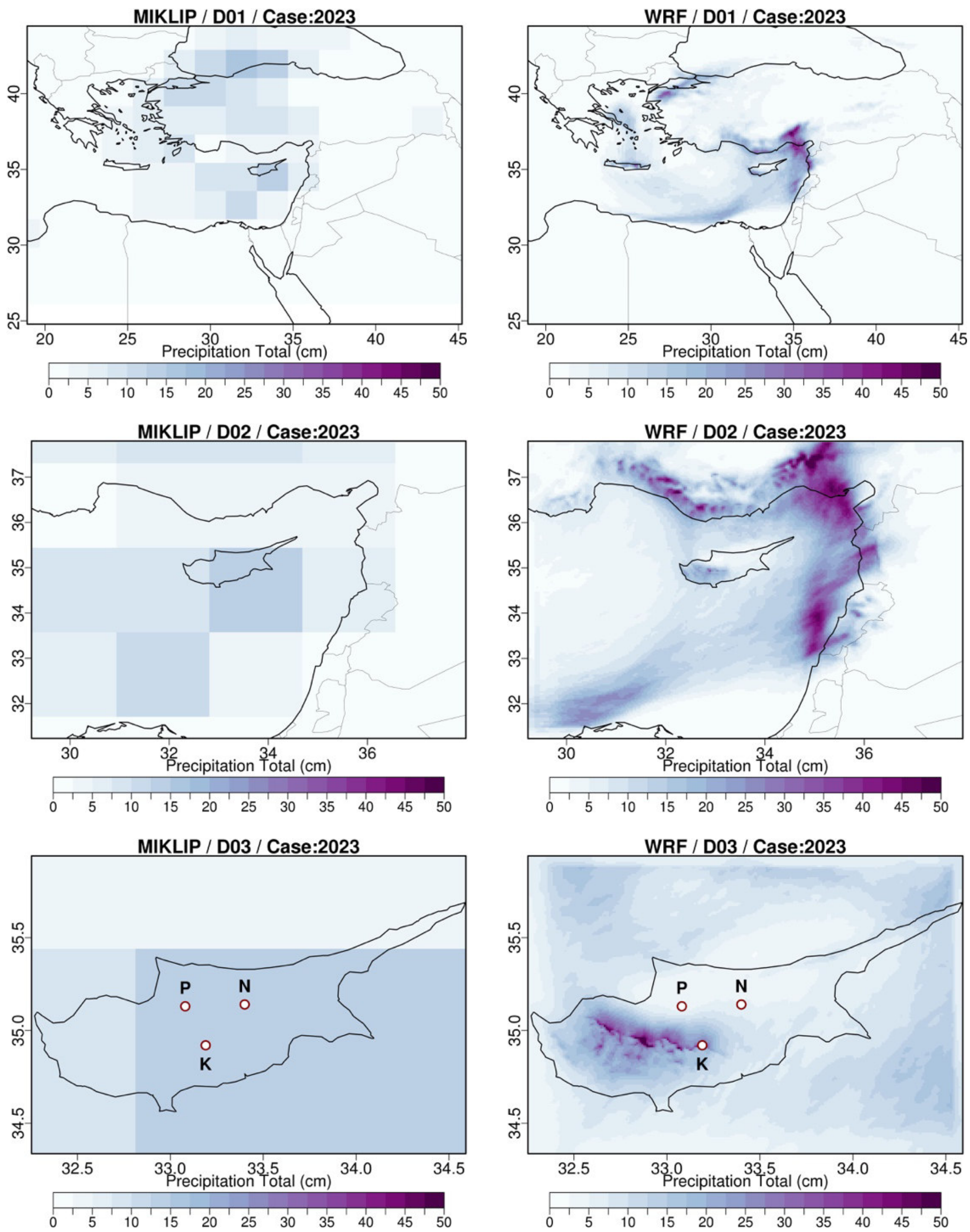

Figure 7 – Precipitation total over a 5-day period (12-16/11/2023) according to the Miklip decadal prediction system (left panels) and the ensemble mean of five WRF simulations (right panels). Letters in the bottom panels indicate Nicosia (N), Peristerona (P) and Kionia (K) station locations.

The time-series of Figure 8 indicate that according to MiKlip (black curve) the event had a prolonged duration of about a week. This was not the case for the WRF downscaling that produced a shorter episode, while it also suggests a smaller-scale secondary event towards the end of the simulation. For the Peristerona region (Figure 8 – top left), WRF is found much drier than Miklip. For the capital city Nicosia (Figure 8 – bottom) MiKlip and WRF agree but only on the first precipitation peak on the 14th-15th of November. The downscaling results are more interesting for the semi-mountainous Kionia region (Figure 8 – top right). The high-resolution simulations (D03) suggest precipitation rates of 185 mm/24h during the peak of the event. Interestingly, this is out of the distribution of maximum daily precipitation for the specific site. Based on observations of the Cyprus Departments of Meteorology a similar-magnitude event occurred only once during the period 1980-2010. This outlier episode had a peak of 190 mm/24h, nevertheless its 5-day total precipitation (257 mm) was about the half of what WRF reproduced for the 2023 case (418 mm). If events of such magnitude occur in the future, the risk for severe impacts and flooding in the downstream urban areas will be increased. This motivates the further research in following BINGO WPs that will also involve hydrological impact models.

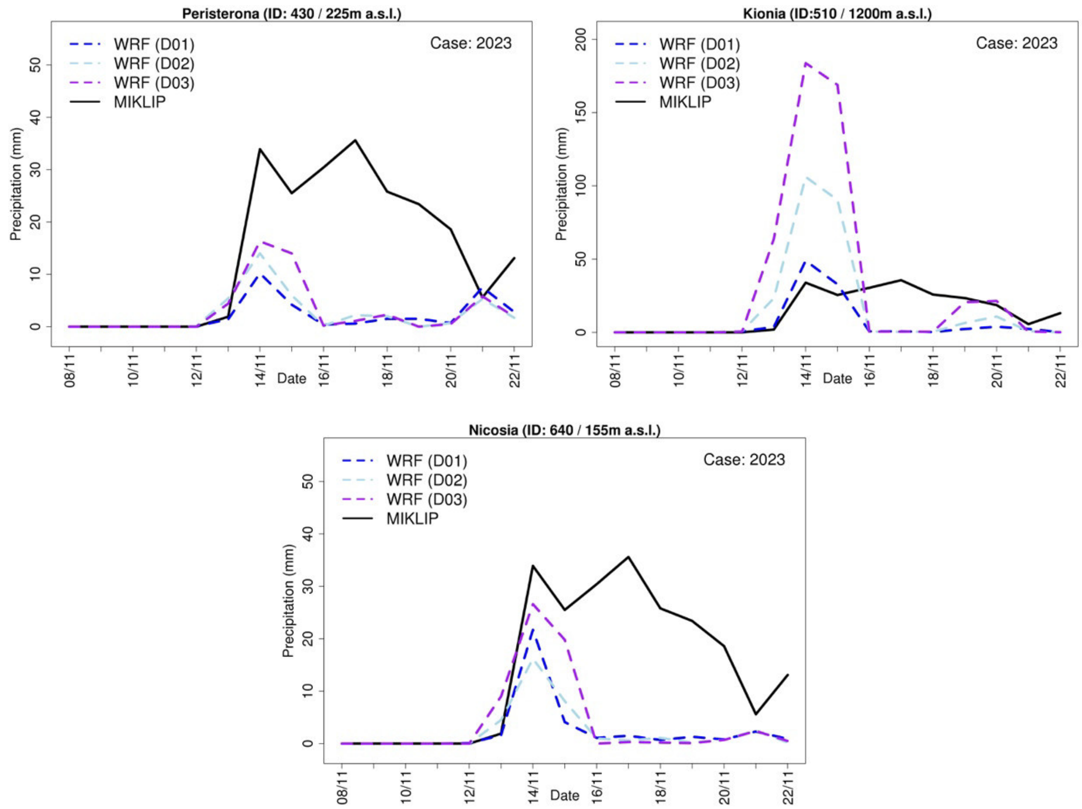

Figure 8 – **Simulated precipitation time-series for the period 08-22/11/2023 over Peristerona, Kionia and Nicosia station locations in Cyprus.**

4. CONCLUSIONS AND DISCUSSION

Several potential future extreme events based on the MiKlip decadal predictions were identified. This MiKlip ensemble set resulted in 100 simulation years (10 members, times 10 years for each member). Three of the most significant events in terms of rainfall amounts over Cyprus were identified and then downscaled with WRF.

As expected, the coarse-resolution MiKlip precipitation was uniformly distributed over Cyprus which was covered only from two grid cells. For the low-elevated Mesaoria plain and coastal regions MiKlip rainfall was found to be greater than what was produced by WRF. Noteworthy, the two MiKlip grid points over Cyprus are considered by the global model as sea.

On the contrary, WRF model and especially the high-resolution D03 simulations are found to produce much higher precipitation amounts particularly over the high-elevation regions. This is in line with observational records and is likely related to the local triggering of precipitation due to the much more realistic orography, which is not considered in the coarse global simulations.

Although not relevant for the Cyprus Troodos mountains research site, MiKlip is found to produce large amounts of precipitation over continental Turkey during all three selected events. This is not the case for the higher-resolution WRF simulations (D01: 12-km) that were found to be substantially drier.

All the selected downscaled events produced large amounts of rainfall. However, in particular the WRF simulations for the extraordinary November 2023 case raise concern and motivate the further study of the impact of such extreme events under a changing climate.

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APPENDIX A:

Identification of Extremal Episodes for Cyprus

Edmund Meredith (FUB)

I. INTRODUCTION

To identify extremal episodes for the Cyprus research site, a modified version of the approach used for all other research sites has been applied. The approach applied to the other research sites is described in detail in deliverable 2.4 (D2.4). This document shall thus focus on how the method has been adapted to the Cyprus site.

II. METHODOLOGY

In broad terms, the method is based on the identification of distinct large-scale weather patterns associated with observed extreme precipitation events in a region of interest. Once the patterns are identified, these are then used as reference extremal patterns with which to compare daily global model data against. If the large-scale fields for a given day are "similar" to one of the extremal reference patterns, then this day is identified as having an extremal circulation pattern. Once such a day has been identified, additional local-scale (i.e. in the region surrounding the catchment) tests are performed in order to reduce the number of false alarms. The local-scale tests involve assessing whether meteorological indicators of extreme precipitation are also present. These tests are site-specific and may include indicators such as humidity, atmospheric instability, atmospheric divergence or model precipitation. More detail is given below.

How are the observed extreme precipitation events chosen?

For all non-Cyprus sites, the observed events were chosen by the FUB by selecting all days for which observed rainfall exceeded a threshold (usually 99.9-th or 99.8-th percentile) anywhere in the catchment. For the site at Cyprus, the CYI identified the strongest observed precipitation events in their catchment and selected 4 of the top 8 for further study (Table A1).

Table A1 – Top eight past events identified by CYI and the four ones chosen for downscaling.

Date	Rank	Downscaled?
1988-12-24	6	Yes
1989-01-09	8	Yes
1992-12-01	2	No
1994-11-20	7	Yes
2001-12-02	3	No
2003-02-12	5	No
2004-01-11	4	No
2010-01-18	1	Yes

How are the extremal weather patterns identified from the extreme precipitation events?

For the non-Cyprus sites, a k-Means-based clustering was applied to the ERA-Interim 500-hPa geopotential height (Z500) anomalies of each day with a precipitation extreme. The resulting cluster means form the reference patterns. For Cyprus, the reference patterns are simply taken as the Z500 anomalies (Figure A1) of the four events which CYI selected for study (four events are too few for the FUB to perform a cluster analysis). Anomalies are relative to the 1979-2015 November-March (NDJFM) mean. NDJFM was identified by CYI as the main risk period for precipitation extremes in Cyprus.

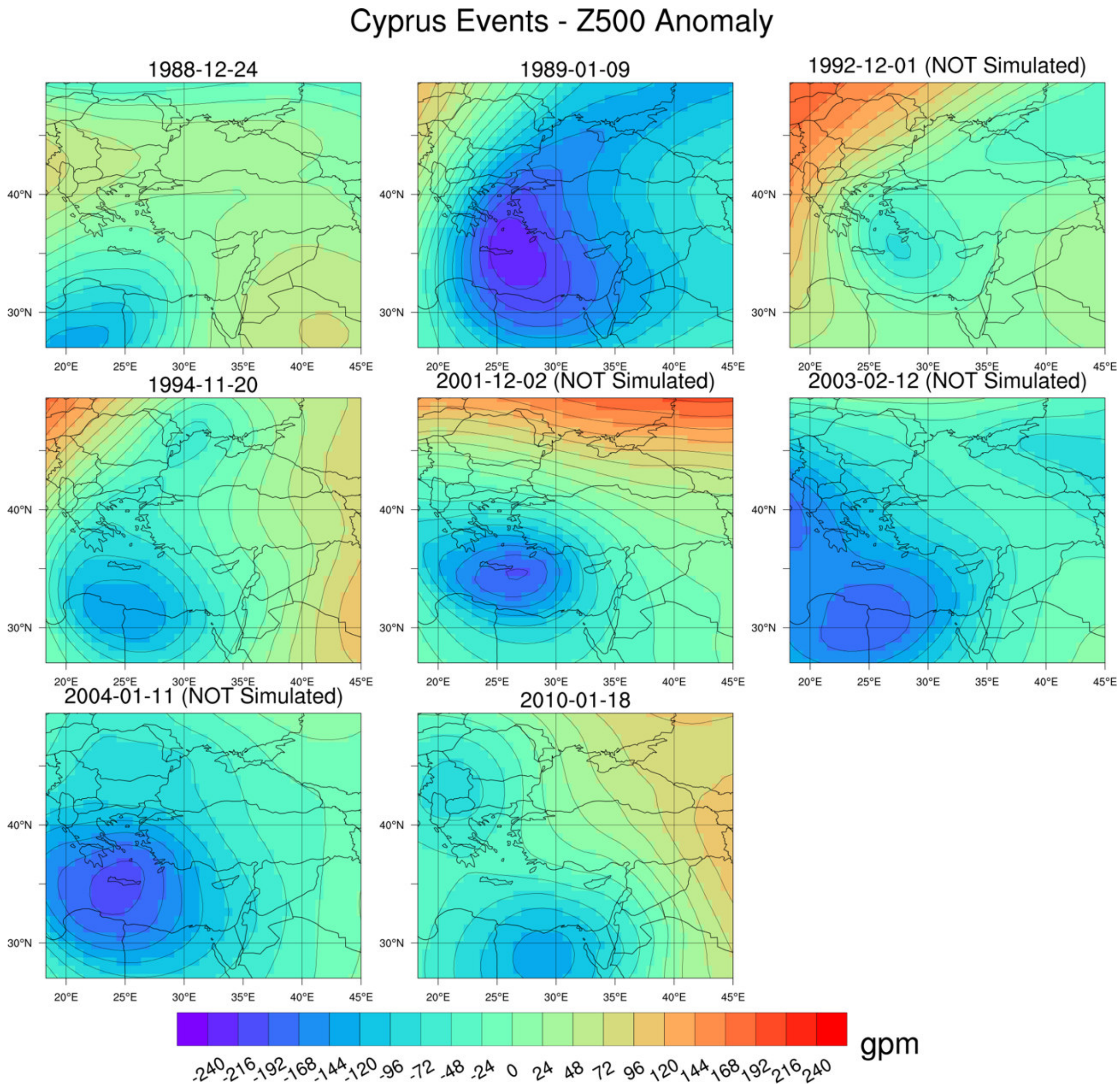

Figure A1 – Anomaly Patterns: Z500 anomalies of the top 8 events identified by CYI, with the 4 not chosen for downscaling indicated by their plot headings. (Data source: ERA-Interim).

How is a given day determined to be "similar" to one of the reference patterns?

For the non-Cyprus sites, the intra-cluster RMSE and pattern correlation (PC) between each cluster member and its cluster mean are computed for all clusters. For each candidate day, the PC and RMSE between the Z500 anomaly that day and each cluster mean is computed. PC (RMSE) thresholds based on the lowest (highest) intra-cluster PC (RMSE) are chosen, and if the PC (RMSE) for the candidate day is above (below) this threshold then the candidate day is chosen as an extreme day (note that the criterion must be passed for both PC and RMSE).

For the Cyprus site, the procedure is basically the same, except that the PC threshold is subjectively chosen (0.67), as clustering was not performed. In addition to this, the

RMSE criterion is dropped as it was deemed superfluous due to the choice of local-scale predictor (see below).

What are the local-scale tests?

Selecting extreme days based on the large-scale patterns alone often produces too many days to feasibly downscale, this is particularly true in regions where the weather patterns that bring extreme precipitation do not differ greatly from those that bring "normal" precipitation. To reduce the number of false alarms, meteorological predictors indicative of a potential for extreme precipitation are assessed in the region of the catchment. The choice of predictor(s) is site and season specific. For the non-Cyprus sites, CAPE, relative humidity, divergence and modelled precipitation (in various combinations) were used as predictors.

For Cyprus, model precipitation was chosen as the sole predictor. Precipitation from the coarse model performs well as a predictor outside of the summer season, i.e. when precipitation extremes are a result of synoptic-scale systems rather than local convective events. All events chosen by CYI from the evaluation period (1979-2015) are in the NDJFM months. Precipitation was also chosen for reasons of consistency - (observed) precipitation was the sole criterion used by CYI to select events to downscale from the evaluation period.

Before reaching the conclusion that model precipitation would be a suitable predictor for the Cyprus site, an analysis of how the top 8 events chosen by CYI were represented in ERA-Interim was performed. ERA-Interim daily NDJFM precipitation from 1979-2015 was taken over the Cyprus observations region (Figure A2) and the magnitudes of the top 8 events were assessed. The top 8 events, as determined by the CYI observations, were not the top 8 events in ERA-Interim (Table A2), as determined from the 3 ERA-Interim grid cells covering the CYI observations region. Despite this, all of the 8 events were above the 99-th percentile of NDJFM daily precipitation in ERA-Interim. Model precipitation above the 99-th percentile was thus taken as the local-scale predictor.

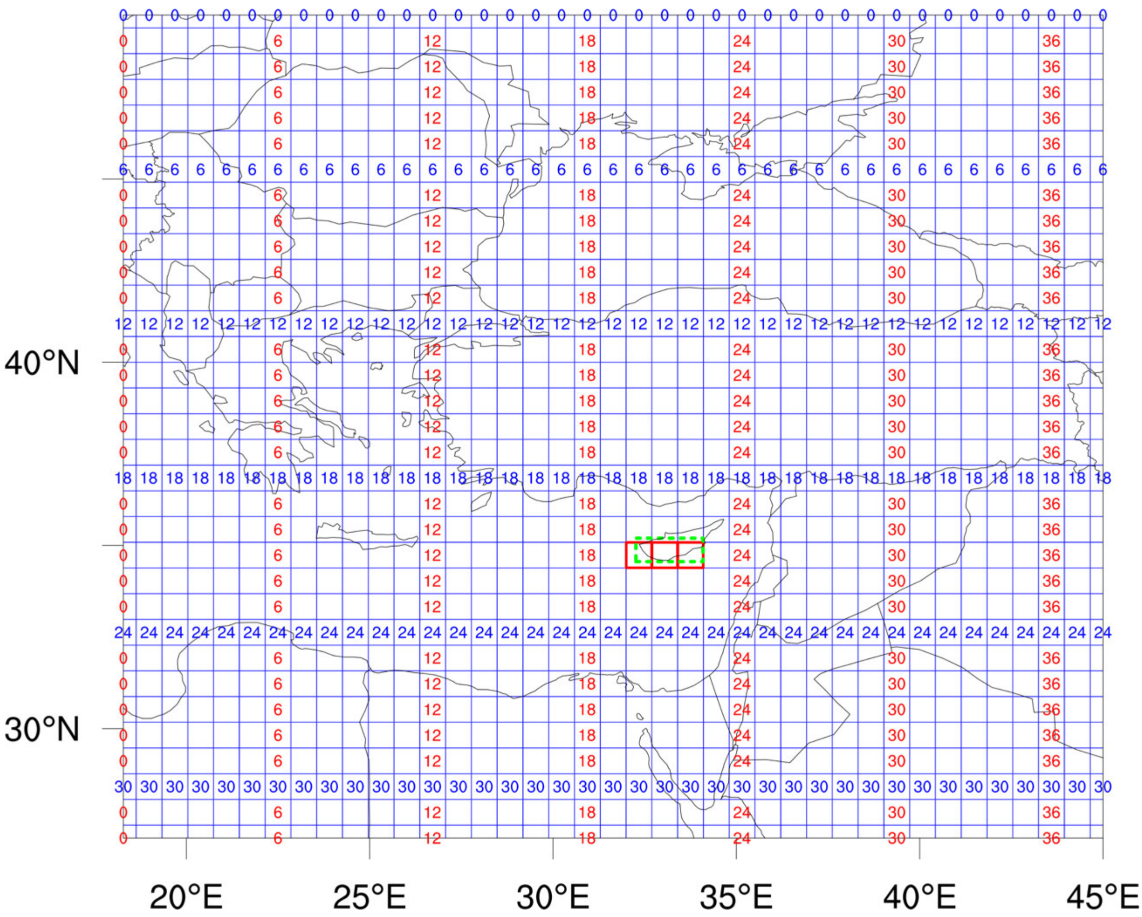

Figure A2 – ERA-Interim grid and Precipitation Regions. The area over which Z500 anomaly patterns are considered (numbers indicate the lat/lon indices). Marked in dashed green is the region over which CYI used observations to rank the events (excluding sea points). Marked in red are the ERA-Interim grid-cells over which model precipitation is assessed.

Table A2 – ERA-Interim rank of the top eight events identified by CYI, as well as the observed rank (right column). Cells 1, 2, 3 refer to the cells marked in red in Figure A2, from west to east.

Event	Cell 1 Rank	Cell 2 Rank	Cell 3 Rank	Max. Rank	Obs. Rank
1988-12-24	81	49	121	49	6
1989-01-09	22	15	20	15	8
1992-12-01	14	35	67	14	2
1994-11-20	20	25	28	20	7
2001-12-02	12	26	15	12	3
2003-02-12	5	10	33	5	5
2004-01-11	57	46	69	46	4
2010-01-18	69	28	23	23	1

How was the methodology validated?

The method was validated using ERA-Interim data. Firstly, all daily NDJFM Z500 anomalies from 1979-2015 were compared to the reference patterns. Days considered similar to any of the 4 reference patterns were then assessed for model precipitation. If model precipitation was above the 99-th percentile in any of the three cells covering the

Cyprus observations region (Figure A2), then the day was chosen as an extreme day. This resulted in a total of 41 days being selected from the ERA-Interim period. These days and their magnitude rankings are listed in Table A3.

Noteworthy, although the reference patterns were based on the 4 events downscaled by the CYI, the method detected all 8 of the top 8 events selected by the CYI.

How was this method applied to the MiKlip data?

The method was applied almost identically to the MiKlip data. MiKlip Z500 was interpolated to the “clustering” domain (Figure A1, Figure A2) for comparing weather patterns. MiKlip precipitation, however, was left on the MiKlip native grid in order to avoid introducing interpolation errors - a much greater risk for variables with high spatial variability. Model precipitation exceedances were thus considered over 2 MiKlip grid cells (Figure A3).

The MiKlip ensemble consists of ten 10-year members, i.e. 100 years in total. This is ~2.7 times longer than the ERA-Interim period and the methodology thus produces a total of 105 extreme days. The extreme days selected from the MiKlip runs and their magnitude ranking are shown in Table A4 of the appendix.

Table A3: ERA-Interim Validation. All extreme days identified from ERA-Interim by the method, and the rank of ERA-Interim daily precipitation for each of those days. Cells 1, 2, 3 refer to the ERA-Interim cells covering the Cyprus observations region, as marked in red in Figure 2, from west to east. The top 8 days identified by CYI are marked in red.

Event	Rank Cell 1	Rank Cell 2	Rank Cell 3	Maximum Rank
1979-12-05	129	79	49	49
1981-11-28	29	31	54	29
1983-11-11	37	52	141	37
1985-12-21	114	41	57	41
1987-12-18	95	37	31	31
1987-12-21	18	14	12	12
1988-01-11	47	76	212	47
1988-12-24	81	49	121	**49**
1989-01-09	22	15	20	**15**
1991-11-02	1	2	8	1
1991-11-03	152	102	44	44
1991-12-08	28	23	19	19
1991-12-11	38	21	3	3
1992-02-03	2	1	1	1
1992-12-01	14	35	67	**14**
1994-11-20	20	25	28	**20**
1994-11-21	40	30	11	11
1994-11-22	109	39	42	39
1996-01-02	48	74	324	48
1996-01-03	36	60	80	36
1996-12-04	35	78	193	35
1998-12-17	209	107	36	36
2000-11-28	3	17	61	3
2000-11-29	7	4	5	4
2001-12-02	12	26	15	**12**
2001-12-08	23	34	39	23
2002-01-05	51	18	29	18
2003-02-12	5	10	33	**5**
2004-01-11	57	46	68	**46**
2004-02-04	90	47	56	47
2006-02-08	42	200	201	42
2007-02-03	24	5	4	4
2007-02-05	4	12	40	4
2009-01-30	33	67	103	33
2009-12-05	405	166	52	52
2009-12-11	21	27	21	21
2010-01-18	69	28	23	**23**
2011-11-14	11	19	26	11
2011-11-15	125	95	50	50
2015-01-14	43	188	599	43
2015-03-11	437	36	37	36

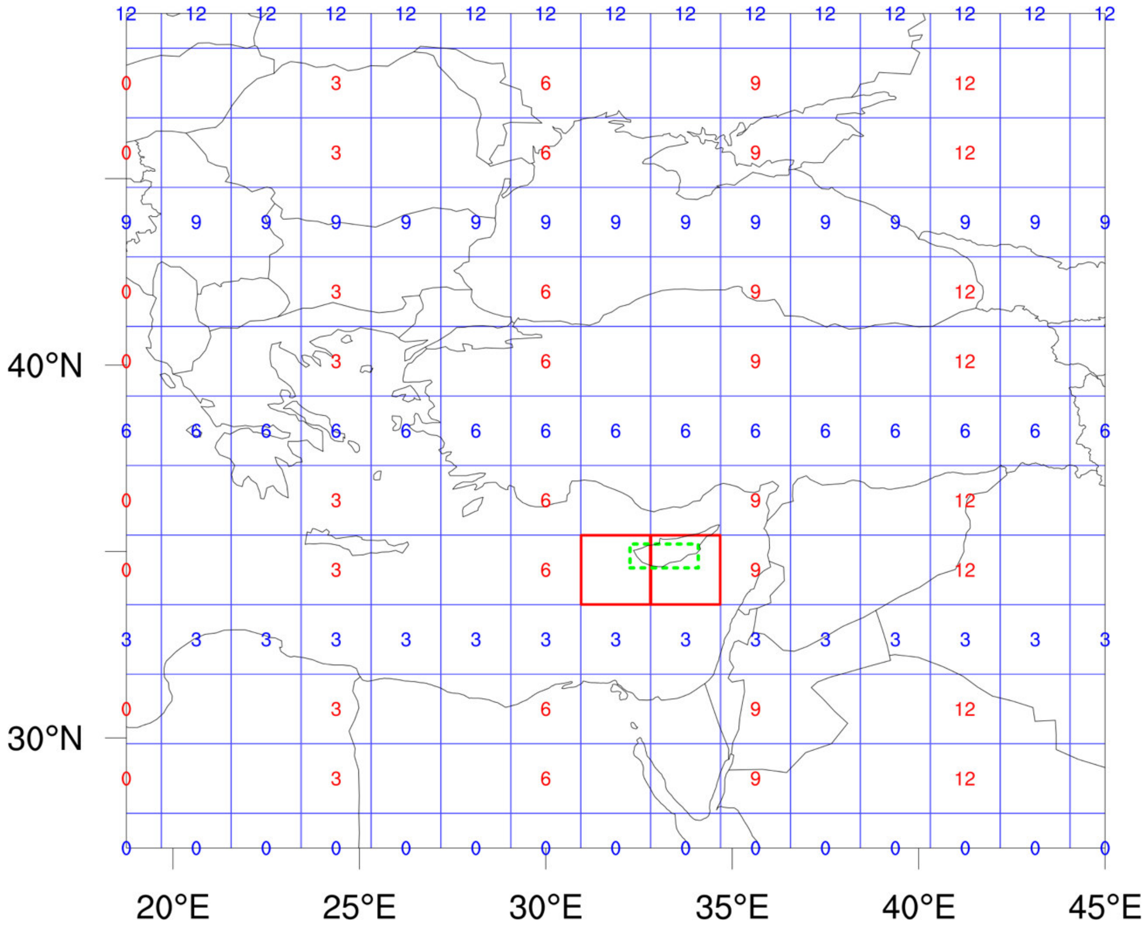

Figure A3 – MiKlip grid and Precipitation Regions. The MiKlip native grid on which precipitation is assessed. The red and green boxes indicate the CYI observation region and the MiKlip precipitation cells respectively. Numbers indicate lat/lon indices.

Table A4 – All MiKlip extreme days identified from the MiKlip ensemble (2015- 2024, 10 members) by the method, and the rank of MiKlip daily precipitation for each day. Cells 1, 2 refer to the MiKlip cells covering the Cyprus observations region, as marked in red in Figure A3, from west to east.

Member	Event	Rank Cell 1	Rank Cell 2	Maximum Rank
1	2016-01-16	139	824	139
1	2017-11-09	91	388	91
1	2018-11-06	93	6071	93
1	2018-11-07	62	1532	62
1	2019-12-06	104	407	104
1	2019-12-08	63	56	56
1	2019-12-09	112	75	75
1	2020-11-27	18	6	6
1	2022-01-08	97	510	97
1	2022-12-03	46	77	46
1	2022-12-18	2	15	2
1	2023-11-11	11	63	11
1	2023-11-12	80	88	80
1	2023-12-30	151	155	151
2	2015-01-12	450	11	11
2	2015-12-14	77	1301	77
2	2015-12-15	16	61	16
2	2017-12-09	525	105	105
2	2018-11-01	645	118	118
2	2018-11-02	218	141	141
2	2022-11-26	136	3943	136
2	2023-01-05	75	226	75
2	2024-03-17	73	216	73
2	2024-03-18	734	114	114
2	2024-11-25	270	72	72
3	2018-02-20	64	268	64
3	2020-12-10	48	320	48
3	2020-12-29	90	559	90
3	2021-12-23	1858	110	110
3	2024-11-23	30	57	30
4	2015-02-18	105	296	105
4	2015-02-19	123	351	123
4	2015-12-01	4	16	4
4	2015-12-02	31	273	31
4	2016-12-21	127	817	127
4	2017-11-29	10	238	10
4	2020-12-03	438	120	120
4	2020-12-25	107	33	33
4	2021-02-25	119	165	119
4	2021-11-05	114	560	114
4	2022-11-28	272	102	102

5	2017-01-09	140	350	140
5	2020-02-16	360	7	7
5	2020-02-29	2375	67	67
5	2021-01-18	215	132	132
5	2021-12-28	2837	51	51
5	2024-12-26	66	544	66
6	2017-11-14	5	84	5
6	2019-12-05	37	176	37
6	2019-12-12	133	211	133
6	2020-11-04	49	175	49
6	2021-01-14	111	22	22
6	2022-11-11	71	1410	71
7	2015-11-30	3	123	3
7	2015-12-01	1152	36	36
7	2016-11-10	148	139	139
7	2017-11-16	17	1795	17
7	2018-12-02	1	342	1
7	2018-12-03	39	76	39
7	2018-12-04	798	59	59
7	2018-12-29	98	78	78
7	2018-12-30	106	161	106
7	2023-01-25	118	94	94
7	2024-11-05	26	3138	26
8	2015-12-12	85	2	2
8	2016-12-13	78	28	28
8	2017-01-05	150	82	82
8	2018-11-07	99	447	99
8	2018-12-25	2363	115	115
8	2019-01-03	205	125	125
8	2020-01-13	69	29	29
8	2022-01-02	28	17	17
8	2022-01-21	141	383	141
8	2023-11-29	53	381	53
8	2023-11-30	115	1310	115
8	2024-03-04	74	655	74
8	2024-03-07	143	244	143
8	2024-12-12	130	996	130
8	2024-12-13	19	41	19
8	2024-12-14	144	246	144
9	2015-11-17	101	838	101
9	2015-12-02	12	71	12
9	2017-01-01	95	234	95
9	2017-11-13	2437	113	113

9	2017-11-14	334	98	98
9	2018-12-20	2241	129	129
9	2019-12-21	329	101	101
9	2021-12-11	643	112	112
9	2021-12-13	7	54	7
9	2022-01-22	347	91	91
9	2023-11-14	188	38	38
9	2023-11-15	20	156	20
9	2023-11-16	201	73	73
9	2023-11-17	1067	23	23
10	2016-01-04	124	80	80
10	2016-12-08	92	460	92
10	2018-12-04	32	162	32
10	2018-12-05	24	279	24
10	2018-12-06	126	200	126
10	2021-12-19	84	1395	84
10	2021-12-28	120	330	120
10	2022-01-22	47	365	47
10	2022-01-23	51	134	51
10	2023-01-05	934	45	45
10	2024-01-06	155	21	21